

**"GAUZE-ETHER," OR A MODIFIED DROP METHOD,
WITH ITS EFFECT ON ACETONURIA.**

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OUR intention in this paper is to describe in some detail the method of etherization introduced by us into the Boston City Hospital, to point out its advantages, and to consider especially its effect on post-operative acetonuria.

The method of etherization employed by us is as follows: A square pad of gauze twelve layers thick, and sufficiently large to cover the patient's mouth and nose, extending well down over his cheeks, is laid directly on the patient's face. Ether is then dropped on this gauze by means of a drop bottle consisting simply of an ordinary bottle with a small wick inserted through a slit in the cork. Ether having been dropped slowly for about one minute on this pad of gauze described above, another similar pad is laid on the first, and the rapidity of the drops is increased and continued until the patient becomes thoroughly anæsthetized. It is very important that the ether should be gradually administered in this way, and not poured on in large quantities at a time, which not only hampers the etherizer in getting the patient narcotized, but also is inconvenient on account of the possibility of causing ether burns on the face, respiratory spasm, or at least coughing. When, however, the ether is administered as directed, the strength of the vapor is so gradually increased that the respiratory tract becomes accustomed to it without any sense of suffocation on the part of the patient. With this lack of sense of suffocation, and no incentive to struggle, we find that the stage of excitement referred to in all text-books on anaesthesia, and seen usually with other methods, is as a rule not recognizable; and that there is no necessity of having an assistant to restrain the patient while he is taking the ether.

The question is now naturally asked, "How long does it take to produce complete surgical anaesthesia by this method?" In answer we would say that the average time is about five minutes. In our series of 102 cases, the average time was four minutes and twenty-nine seconds. The shortest time was one minute and a half, and the longest ten minutes.

Next, how much ether does it require? Of course, the amount of ether necessary to produce and maintain anaesthesia, with this as with other methods, varies according to the patient. In our series the average amount required to produce and maintain anaesthesia was seven ounces per hour. In one case on which a gastro-enterostomy and cholecystotomy was done, the duration of the operation being one hour, only one and one-half ounces of ether were used during the whole time. The above facts show conclusively that in this way complete narcosis can be quickly produced and maintained with a small amount of ether.

Now, let us consider the objections which have been raised to this method:

First, it has been suggested that the ether being dropped on gauze placed so close to the patient's face must chill the respiratory tract, and be a causative factor in producing bronchitis or pneumonia. At first thought it seems as though this idea might be well founded and true. But if anybody using this method properly, by which we mean using it as a drop method, and not pouring on large quantities of ether at a time, will take the trouble to place his finger between the patient's mouth and the gauze, he will find that it is not only not cold, but that it is far warmer than when placed inside any metal cone.

This observation led us to believe that for one reason at least, bronchitis was less apt to occur, and on investigating the subject we found this was in point of fact true. Dr. Ladd made three visits at different times to every patient on the service on which he worked. He found on the three visits, two cases with bronchitis, one of which had it before etherization, and with whom it persisted afterward and was of considerable

severity. The other was very slight, and cleared up in two or three days. Dr. Osgood, on the service on which he worked, found one case of ether pneumonia which had not been etherized by him, or by the gauze method, but by a house-officer of considerable experience in anaesthesia and with a Blake cone.

Now, with regard to etherizing alcoholics by this method. We have been fortunate in having some patients who had to be anaesthetized twice. The first time with the cone they were etherized with great difficulty, whereas on the second, with the gauze they were narcotized far more easily. This, with the fact that the alcoholic patients as a rule cause us less difficulty with the gauze than with the cone, leads us to the belief that the gauze method is particularly suited to that type of patient.

The other objections which have been raised are the likelihood of ether burns on the face, or ether conjunctivitis. To this we consider it sufficient to state that no patient etherized by the writers has ever had either of these sequelæ.

If we consider the ideal etherization that in which there is the greatest amount of fresh air with the minimum volume per cent. of ether necessary to produce anaesthesia, we must of necessity regard any closed, or semi-closed method as directly antagonistic to the first principles of etherization, for thus we do our utmost to exclude oxygen.

Having seen that the objections offered against the method do not exist when it is intelligently applied, let us consider whether it has advantages sufficient to recommend its more general adoption. First and foremost we believe that the comfort and the feelings of the patient should always be considered. We have been fortunate enough to have had several patients who had previously been etherized by the cone or other methods. Every one of them expressed a preference for the gauze method.

Next, with this method the usual absence of the stage of excitement and struggling must be beneficial to the patient's general welfare. The time required to produce anaesthesia in this way being less than by any other method of etherization with the exception of the gas-ether sequence, is of course of

value for the convenience of the operator and also beneficial for the patient.

The difference in the patient's recovery is very marked. So rapidly do they come out of ether that by the time the dressing is applied and the patient taken to the recovery ward, he is frequently able to assist himself from the truck to the bed, and even to answer questions rationally before being removed from the operating table.

With regard to vomiting: We were unfortunately not able to observe all the cases, but 52 out of 77 patients whom we did see, did not vomit at all, 19 vomited once or twice, and 6 presented the usual distressing degree of vomiting following etherization in other ways.

In other words, 67½ per cent. of the patients did not vomit at all, and of the 32½ per cent. who did, only 8 per cent. exhibited marked and distressing vomiting.

We have also compared the effect of the gauze method with that of the cone in producing post-operative acetonuria, making observations in 222 cases in which there was no acetone before operation.

It has been generally considered that, barring organic disease or idiosyncrasy of the patient, ether alone does not produce any lasting unfavorable effect; Grevin, however, has shown that there is enough disturbance in metabolism in almost every case of anæsthesia to cause a marked acetone reaction in the urine.

Of the several tests for acetone, the following proved to be the most practical and satisfactory:

To one-quarter test tube of urine add a few drops of a saturated solution of sodium nitro-prussiate. Then add a few drops of glacial acetic acid and shake thoroughly. Now pour down the side of the tube 2 c.c. of ammonium hydrate. If acetone be present, there will appear at the line of contact, a crimson red zone which gradually changes to deeper red, and if much acetone be present, becomes diffused throughout the fluid, being at first more intense and fading later. Sometimes the colored zone does not appear for several minutes.

This test detects 8 mll. of acetone in the twenty-four hour amount of urine.

With this test we first examined the urines of 120 patients etherized with the cone or semi-open method, following a few of them as long as four days after the operation. All these patients were etherized with the Blake cone, no gas being used and the duration of the etherization varying from fifteen minutes to two hours and a half.

Of these 120 cases, 106 showed varying amounts of acetone, the intensity of the reaction in many cases being in direct proportion to the duration of the etherization. Out of the 14 cases not giving the reaction for acetone, there were but 5 where the administration of the anaesthetic exceeded twenty minutes, and only one where etherization was continued for one hour.

In every case here recorded the acetonuria developed before the eighteenth hour after operation. Of 10 cases where the first urine was voided within six hours after etherization, 9 showed acetone. The other case had acetone in the urine at the end of eighteen hours.

As to the time of the disappearance of acetone from the urine we can only say that we have found it in a number of cases up to the fifth day.

That acetone may be due to a restricted diet before or after operation is possible, and with this idea in view we examined the urine of four patients etherized on a full stomach with the cone. All 4 cases showed acetonuria. This, together with the definite relation between the length of etherization and the intensity of the reaction, shows that the sole cause of acetone in these post-operative urines, cannot be the restricted diet before and after operation,—furthermore, three of these patients had compound fractures and were on house diet twenty-four hours after operation, although acetone continued in the urine to the fourth and fifth day.

In these 120 post-operative urines examined, 106, or 88½ per cent. showed acetone.

These results, corresponding very closely with those of

other observers, would lead one to suppose that acetone appears in the urine after ether narcosis in about 90 per cent. of the cases. Now although acetone does occur in this large majority of cases, it is only in a very few that it is accompanied by the grave symptoms of acid intoxication, which are characterized by an odor of acetone in the breath, nausea, followed by vomiting, coming on 12 to 36 hours after operation. The vomiting increases, the pulse becomes very rapid and feeble, respirations increase and grow shallow, the patient may become delirious or comatose, and finally die at the end of twelve to forty-eight hours.

Now, though every case having acetone in the urine does not present serious symptoms, neither does every case of diabetes present serious symptoms. Still, we well know that acetone in quantities sufficiently large to be detected by any of the ordinary tests is a pathological constituent of the urine and indicates some metabolic change which may be more or less serious, occasionally serious enough to cause death and to show fatty degeneration of the liver and kidney post mortem, as has been demonstrated by Bevan, but more frequently this is not severe enough to produce any easily noticeable symptoms.

Whether or not acetone is the cause of the disease which presents the above symptoms is not yet settled, but we do know that the patients showing the symptoms have invariably had acetone in the urine in the cases in which it has been tested, we therefore believe that it should be regarded as a danger signal following anæsthesia and that every effort should be made to avoid its occurrence or to diminish its quantity in the urine.

The question which naturally arises is "How can this be done?" We have already stated that 88½ per cent. of the patients etherized by the semi-open or cone method showed acetone in the urine, while the employment of the simpler, cleaner, and more rational method of anæsthesia which we have described, reduced the percentage of post-operative acetonuria from 88½ to 26 per cent.

In conclusion, we may summarize the advantages that we claim for the gauze method of etherization, thus—

1. It is less disagreeable to the patient.
2. Post-operative vomiting is reduced from nearly 100 to 32½ per cent.
3. Quicker recovery of consciousness.
4. Reduction of post-operative acetonuria from 88½ to 26 per cent.

In closing, we wish to express our thanks to Drs. Burrell, Watson, and Blake, through whose courtesy we have had the opportunity to carry out this work, and especially to thank the latter, at whose suggestion the work on acetone was undertaken, for his valuable advice and encouragement.